Claims

1. An implant having a coating on its external surface comprising:

a) a crosslinked, water swellable polymer matrix having a dry thickness of at least 0.1 μm, and

b) a pharmaceutically active compound

in which the polymer has pendant zwitterionic groups and pendant cationic groups.

2. An implant according to claim 1 in which the pharmaceutically active compound comprises a nucleic acid.

3. An implant having a coating on its external surface comprising:

a) a crosslinked, biostable polymer matrix and

b) a pharmaceutically active compound which is a nucleic acid, in which the polymer has pendant zwitterionic groups and pendant cationic groups.

4. An implant having a coating on its external surface comprising:

a) a cross-linked, biostable polymer and

b) a pharmaceutically active comound which is a protein which is anionically charged at physiological pH in which the polymer has pendant zwitterionic groups and pendant cationic groups.

5. An implant according to claim 4 in which the protein is an antibody or fragment thereof.

6. An implant according to any preceding claim in which the polymer is formed from ethylenically unsaturated monomers including less than 20 mole % cross-linkable monomer.

7. An implant according to any preceding claim in which the polymer is formed from ethylenically unsaturated monomers including

a) a zwitterionic monomer of the formula I

YBX I

wherein B is a bond or a straight or branched alkylene, alkylene-oxa-alkylene or alkylene-oligooxa-alkylene group, any of which optionally include one or more fluorine substituents;

X is an organic group having a zwitterionic moiety; and

Y is an ethylenically unsaturated polymerisable group;

b) a cationic monomer of the formula II

$Y^1B^1Q^1$ II

wherein B^1 is a bond or a straight or branched alkylene, alkylene-oxa-alkylene or alkylene-oligooxa-alkylene group, any of which optionally includes one or more fluorine substituents;

Y^1 is an ethylenically unsaturated polymerisable group; and

Q is an organic group having a cationic or cationisable moiety and

c) a crosslinkable monomer having the general formula IV:

$Y^3B^3Q^3$ IV

wherein B^3 is a bond or a straight or branched alkylene, alkylene-oxa-alkylene or alkylene-oligooxa-alkylene group, any of which optionally includes one or more fluorine substituents;

Y^3 is an ethylenically unsaturated polymerisable group; and

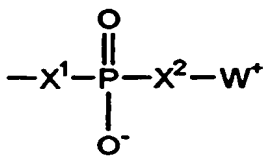
Q^3 is an organic group having a reactive group capable of cross-linking the polymer.

8. An implant according to claim 7 in which Q^3 contains a crosslinkable cinnamyl, epoxy, $-CHOHCH_2Hal$ (in which Hal is a halogen atom), methylol, or reactive silyl group, an ethylenically unsaturated crosslinkable group, such as an acetylenic, diacetylenic, vinylic or divinylic group, or an acetoacetoxy or chloroalkyl sulfone, preferably chloroethyl sulphone, group.

9. An implant according to claim 8 in which Q^3 is a group SiR^4_3 in which each R^4 is a C_{1-4} alkoxy (preferably methoxy) group or a halogen atom.

10. An implant according to claim 9 in which the monomers further include a compound.

11. An implant according to any of claims 7 to 10 in which X is a group of formula V



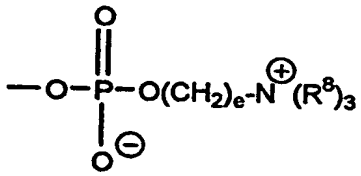
(V)

in which the moieties X^1 and X^2, which are the same or different, are -O-, -S-, -NH- or a valence bond, preferably -O-, and W^+ is a group comprising an ammonium, phosphonium or sulphonium cationic group and a group linking the anionic and cationic moieties which is preferably a C_{1-12}-alkylene group.

12. An implant according to claim 11 in which the ethylenically unsaturated groups of all monomers copolymerised together are either the acrylate type or are the styrene type (CH_2=C(R)C(O)A- or CH=CH-(C_6H_4)K), and preferably each has the same formula.

13. An implant according to claim 12 in which W^1 is a straight-chain alkylene group, most preferably 1,2-ethylene.

14. An implant according to any of claims 11 to 13 in which X is a group of formula VI



(VI)

where the groups R^8 are the same or different and each is hydrogen or C_{1-4} alkyl, and e is from 1 to 6, preferably all R^8's being the same, more preferably CH_3, and C preferably being 2 or 3.

15. An implant according to any of claims 7 to 14 in which Q^1 is a group $N^+R^5_3$, $P^+R^5_3$ or $S^+R^5_2$

in which the groups R^5 are the same or different and are each hydrogen, C_{1-4}-alkyl or aryl (preferably phenyl) or two of the groups R^5 together with the heteroatom to which they are attached from a saturated or unsaturated heterocyclic ring containing from 5 to 7 atoms.

16. An implant according to any of claims 6 to 15 in which the monomers further include a termonomer of the formula III

$Y^2B^2Q^2$ III

wherein B^2 is a bond or a straight or branched alkylene, alkylene-oxa-alkylene or alkylene-oligooxa-alkylene group, any of which may optionally include one or more fluorine substituents;

Y^2 is an ethylenically unsaturated polymerisable group; and

Q^2 is an organic group having a hydrophobic group selected from alkyl groups having at least six carbon atoms, fluorine substituted alkyl groups and alkyl groups having at least one siloxane substituent.

17. An implant according to any of claims 7 to 16 in which Y, Y^1, Y^2, Y^3 and/or Y^3', as the case may be are independently selected from CH=CH-(C_6H_4)-K-, CH_2=C(R)C(O)-A-, CH_2=C(R)-CH_2-O-, CH_2=C(R)-CH_2OC(O)-, CH_2=C(R)OC(O)-, CH_2=C(R)O-, and CH_2=C(R)CH_2OC(O)N(R^1)- wherein:

R is hydrogen or a C_1-C_4 alkyl group;

A is -O- or -NR^1- where R^1 is hydrogen or a C_1-C_4 alkyl group or R^1 is -B-X, B^1Q^1, B^2Q^2 or B^3Q^3, as the case may be, where B, B^1, B^2, B^3, Q^1, Q^2 and Q^3 and X are as defined above in the respective one of the formula I to IV and

K is a group -$(CH_2)_p$OC(O)-, -$(CH_2)_p$C(O)O-, -$(CH_2)_p$OC(O)O-, -$(CH_2)_p$$NR^2$-, -$(CH_2)_p$$NR^2$C(O)-, -$(CH_2)_p$C(O)$NR^2$-, -$(CH_2)_p$$NR^2$C(O)O-, -$(CH_2)_p$OC(O)$NR^2$-, -$(CH_2)_p$$NR^2$C(O)$NR^2$-, (in which the groups R^2 are the same or different) -$(CH_2)_p$O-, -$(CH_2)_p$$SO_3$ -, or, optionally in combination with B, a valence bond and p is from 1 to 12 and R^2 is hydrogen or a C_1-C_4 alkyl group.

18. An implant according to claim 17 in which the ethylenically unsaturated groups of all monomers copolymerised together are either the acrylate type or are the styrene type (CH_2=C(R)C(O)A- or CH=CH-(C_6H_4)-K-), and, preferably each has the same formula, more preferably the formula CH_2=C(R)C(O)A in which R is H or CH_3 and A is -NH or -O-, most preferably in which A is -O-.

19. An implant stent according to any preceding claim in which the polymer matrix has a dry thickness of at least 0.5µm, preferably at least 1µm.

20. An implant according to claim 2 or claim 3 in which the nucleic acid is DNA or RNA, and may be linear or circular, single or double stranded.

21. An implant according to claim 1, claim 3 or claim 4 in which the pharmaceutically active compound has a molecular weight higher than lkD, preferably higher than 1.2kD.

22. An implant according to any preceding claim in which the polymer is formed from ethylenically unsaturated zwitterionic monomer and ethylenically unsaturated cationic monomer and in which the ratio of zwitterionic to cationic monomer used to form the polymer is in the range 1:100 to 100:1, preferably 1:10 to 10:1, more preferably 1:2 to 2:1.

23. An implant according to any preceding claim which is a stent.

24. A method of producing an implant according to any preceding claim in which an empty implant, having an empty (of pharmaceutical active) coating of cross-linked water-swellable polymer matrix on its external surface is contacted with a solution or dispersion of a pharmaceutical active in a solvent whereby pharmaceutical active or nucleic acid is absorbed into or adsorbed onto the polymer matrix.

25. A method according to claim 24 in which the solvent is capable of swelling partially the polymer matrix and swells it in the method.

26. A method according to claim 24 or 25 in which the polymer matrix is substantially free of solvent when it is contacted with the said solution or dispersion.

27. A method according to claim 24 or 25 in which the polymer matrix has been preswollen with a swelling liquid when it is contacted with the said solution or dispersion.

28. A method according to any of claims 24 to 27 in which the said solution or dispersion is aqueous.

29. A method according to any of claims 24 to 27 in which the said solution or disposition comprises organic solvent, and the method includes a drying step in which the organic solvent is removed from the treated implant, preferably by evaporation.

30. A method according to any of claims 24 to 29 in which the implant is contacted with the said solution or dispersion by dipping it into a volume of the solution or dispersion.

31. A method according to claim 30 in which the implant is a stent.

32. A method according to claim 31 in which the stent is mounted on a delivery device, preferably a catheter.

33. A method according to any of claims 24 to 32 in which the contact time of solution or dispersion and implant is at least 30s, preferably at least 2 minutes, more preferably at least 5 minutes.

34. A method according to any of claims 24 to 33 in which the said solution or dispersion is at a temperature in the range of 0 to 60°C, preferably 20 to 40°C, more preferably about 37°C.

35 A method according to any of claims 24 to 34 including the preliminary step of coating an implant with a cross-linkable polymer and cross-linking the polymer.

36. A method in which an implant according to any of claims 1 to 23 is placed in an environment comprising a liquid medium, whereby the pharmaceutical active is released into the liquid medium.

37. A method according to claim 36 in which the environment is *in vivo* in the body of a human or animal, preferably in a human, most preferably a blood vessel.

38. A method according to claim 36 in which the environment is an *in vitro* test method and the implant is not subsequently delivered to a human or animal.